

Information Collection Request Supporting Statement: Part B Electric Vehicle Inventory and Use Survey (eVIUS)

Abstract:

The Electric Vehicle Inventory and Use Survey (eVIUS) is a United States Department of Transportation (USDOT) program aimed at gaining a deeper understanding of electric vehicle characteristics, usage levels, and charging patterns in the United States. The methodology for the eVIUS program will be an extension of the methodology used in the Vehicle Inventory and Use Survey (VIUS) program, which has run from 1997 to present and the Truck Inventory and Use Survey (TIUS) program, which ran from 1967 to 1992. The eVIUS survey will specifically target battery electric vehicles (BEVs) and plug-in hybrid electric vehicles (PHEVs), surveying a sufficient number of respondents to enable the publication of relevant estimates on a national scale. Electric Vehicles (EVs) are a small proportion of the total US vehicle fleet (1%¹), and they are primarily concentrated in the passenger vehicle classes but are also represented across all Gross Vehicular Weight Rating (GVWR) up to, and including, Class 8 vehicles. A separate survey, focused on the EV population, is needed to adequately analyze EV usage and charging patterns. The Bureau of Transportation Statistics (BTS) is seeking approval to conduct a voluntary survey from a sample of registered EVs. These will include both personal and commercial EV registrations. This survey will be administered to a random sample of registered EVs. A set of the questions focus on collecting data for usage during 2023, while other questions ask about general or typical use. BTS will reach out to the individual or business identified on the registration to obtain responses. BTS will maintain both the survey responses and the administrative data associated with the sample frame (e.g., vehicle make, model, year). BTS will keep the data private and secure in accordance with Confidential Information Protection and Statistical Efficiency Act of 2002 (Title 5 of Public Law 107-347) (CIPSEA) and the Foundations for Evidence-Based Policymaking Act of 2018 (Title 3 of Public Law 115-435). The data will be used to provide aggregate national statistics as well as breakdowns by state and GVWR if the data allows.

B.1. Describe the potential respondent universe and any sampling or other respondent selection method to be used.

Sampling Plan

Sample Frame

The respondent universe is the total personal and commercial fleet of BEVs, and PHEVs registered in the United States. The sampling frame will be based on state vehicle registrations obtained through a third-party source.

¹Electric Cars' Turning Point May Be Happening as U.S. Sales Numbers Start Climb
<https://www.caranddriver.com/news/a39998609/percentage-of-electric-cars-usa/> (Accessed 9/18/2023)

The sample frame will include all BEV and PHEV registrations in all 50 state and the District of Columbia. The frame will be stratified into 918 strata, stratified by geography, GVWR, and fuel type, as detailed below.

Geography: 51 states (including the District of Columbia)

GVWR: 9 classes (small passenger vehicles and GVWR classes 1-8)

Fuel Type: 2 types (BEV and PHEV)

51 geographies * 9 vehicle classes * 2 fuel types = 918 distinct strata

The frame will be analyzed to obtain the number of strata that are actually viable for the survey. It is expected that there will be many combinations of state, GVWR and fuel type that do not have any vehicles, or do not have sufficient numbers of vehicles to make a statistically valid estimate while retaining respondent confidentiality.

Desired sample sizes for each stratum will be sent to the third-party source. BTS will request that the desired samples be selected through simple random selection without replacement from the frame. Each vehicle will have a uniquely identifiable Vehicle Identification Number as well a contact information for the vehicle's registrant.

BTS will reach out to the individual or business associated with the vehicle's registration for responses to the survey.

Sample Design

The sample frame will be divided into strata based on GVWR, fuel type (BEV or PHEV), and state. Vehicles that are not assigned a GVWR are referred to as GVWR 0. From within these strata, a simple random sample will be taken. Additionally, an estimated response rate of 30 percent will be built into the sample size calculation.

Upon obtaining the sample frame, calculations will be performed so that the designed estimation precision for each stratum will meet a minimum coefficient of variation (CV).

For each stratum, a minimum CV of 10% will be targeted. In certain strata (e.g., state), this target will not be attainable due to the uneven distribution of EVs across different strata in the universe of EVs. For example, there are significant differences in both the number of vehicles and the adoption rates between different states and GVWR classes. According to a Department of Energy (DOE) analysis of Experian Automotive data, there were approximately 2.4 million plug-in electric vehicles in the United States in 2022². At two extremes though, North Dakota had 640 registered plug-in electric vehicles and California had over 900 thousand.

Using the below calculations for sample size, we can see that the size of a stratum (N) factors into the sample size to reach a target CV. As with any sample size calculation, an increase in sample size will result in a decrease in expected CV. In cases such as these where there are limits on the size of the stratum as a whole, arbitrarily small CVs will not be achievable as they may require larger samples than the stratum population.

² <https://afdc.energy.gov/data/10962>

We have chosen to apply a variable target for CV depending on the stratum of interest. In this scenario, we will have a lower bound to the CV of 5%. We will select samples from all strata where this target CV is attainable according to the formulas below at the CV target of 5%. For strata where this target CV is not attainable, we will increase our target CV in increments of 0.5% to the minimum CV that is attainable within that stratum.

The sample size calculation for each question is calculated using the following formula from Valliant et al. (2018)³

$$\frac{CV_{pop}^2}{CV_0 + \frac{CV_{pop}^2}{N}}$$

Where:

- CV_{pop}^4 is the coefficient of variation of the population
- CV_0 is the target coefficient of variation
- N is the size of the strata population

For each question, the sample size was calculated as the sum of sample sizes for all strata.

$$\sum_{s \in S} \frac{CV_{pop}^2}{CV_0 + \frac{CV_{pop}^2}{N}}$$

Where:

- S is the set of all Strata
- s is each element of that set

Finally, the maximum sample size across all questions in the survey will be taken as the desired sample size.

$$\max_{q \in Q} \sum_{s \in S} \frac{CV_{pop}^2}{CV_0 + \frac{CV_{pop}^2}{N}}$$

Where:

³ Valliant, R., Dever, J.A., Kreuter, F. (2018). Power Calculations and Sample Size Determination. In: Practical Tools for Designing and Weighting Survey Samples. Statistics for Social and Behavioral Sciences. Springer, Cham. https://doi.org/10.1007/978-3-319-93632-1_4

⁴ The population coefficient of variation was estimated using the maximum coefficient of variation for similar questions from the Federal Highway Administration's National Household Travel Survey.

- Q is the set of all questions
- q is each question

The desired sample size will be the sample size that is the maximum across all questions when you sum the sample size across all strata.

Due to variations in the size of each stratum, the minimum CV attainable in each stratum is different.

It is expected that the total sample will be at most 150,000. We have additionally factored a response rate of 30% into all CV calculations. The effective sample size is expected to be at most 45,000.

Additionally, we will multiply the target sample size by the inverse proportion of expected response rates to ensure that our sample size will meet our estimation needs.

Expected CVs given different sample size constraints

For our preliminary calculations, we have constrained ourselves to looking at 306 strata. This is the combination of 51 geographies, 3 GVWR classes (0, 1, and 2) and two fuel types (BEV and PHEV). Our preliminary data analysis shows that these are the strata with a reasonable chance of having data that can be reported with some measure of statistical accuracy while retaining confidentiality for the respondents. We have eliminated the 612 strata that either have populations of 0 or have populations that are too small to create a reliable estimate while maintaining confidentiality standards. (See Attachment 2).

Preliminary calculations allow us to estimate that 179 out of 306 strata will be sampled sufficiently to achieve a target CV of 5%. The remaining 127 strata would not reach a CV target of 5% regardless of sampling size. For these remaining strata, 88 would have an expected CV of 5%-10%, 33 have a minimum expected CV of 10% - 20% and 6 have a minimum expected CV of 20% - 30%. (See Attachment 3 for more detail).

Our sampling plan involves taking the largest sample we can from each stratum with a minimum CV in mind to optimize sample selection. This strategy will allow us to disproportionately sample larger strata to obtain lower CVs while still obtaining the lowest CV we can from smaller strata.

With a sample size of 150,000 Vehicle Identification Numbers, we can expect a minimum CV of 5% for the larger strata. The smaller strata will still be expected to have a CV of 30%.

Data Analysis

We plan on creating state, regional, and national-level estimates by GVWR and fuel type for a subset of the 33 questions asked.

The responses will be weighted by the inverse probability of selection in the sampling frame.

Additionally non-response will be analyzed, and the non-response weights will be applied before calculating estimates.

BTS will additionally incorporate additional external administrative datasets to combine with the data in order to add context to the data.

These estimations will be made at the national, regional, and statewide level for each GVWR and fuel type. It is possible that we will have the need to roll-up multiple strata into one higher level category for either confidentiality or clearer results.

B.2. Describe the procedures for the collection of information.

Respondents (i.e., owners/lessees of sampled vehicles) will receive a pre-notification postcard (Attachment 4) notifying them that they have been selected for the survey. This will be followed by a mailed survey invitation letter (Attachment 5) that provides two options for accessing the online survey: a survey link and a QR code. In addition, two rounds of reminders will be mailed to all sampled owners/lessees encouraging them to complete the survey if they have not already done so (Attachments 6 and 7). All information will be stored locally on CIPSEA compliant databases within BTS. Respondents will be provided with a secure means of logging onto our CIPSEA compliant server.

An email address and phone number will be provided to respondents to ask questions and get help with the survey.

Respondents will be asked to answer up to 33 questions. Skip patterns are employed in the survey to keep respondents from having to answer questions that do not apply to them. The questions are primarily multiple-choice questions or ask for single values (i.e., odometer reading). The questionnaire and questionnaire rationale are provided as attachments.

B.3. Describe methods to maximize response rates.

Respondents will be contacted by mail to ensure CIPSEA compliance. Survey respondents will receive a pre-notification postcard about eVIUS, which will be followed by the survey invitation letter. These respondent communication materials will include BTS contact information (email address and phone number) in case respondents have any questions about eVIUS or technical difficulties accessing or completing the online survey. Additionally, respondents will be provided multiple reminders and nonresponse follow up communications will be used to encourage participation.

In addition, BTS will reach out to interested parties identified by market research including non-profits, trade organizations, EV infrastructure companies, and clean energy/EV advocacy organizations with marketing and promotional materials and will ask these organizations to encourage survey response.

B.4. Describe any tests of procedures or methods to be undertaken.

The questions on the eVIUS survey will match questions on the VIUS survey wherever possible. The VIUS questions have already undergone extensive cognitive testing. Additionally, the questions have been evaluated by subject matter experts to ensure their relevance and clarity.

The draft eVIUS questionnaire also was pre-tested with five EV owners. Following completion of the online survey, cognitive interviews (one hour in length) were conducted with each pre-test participant to walk through the questionnaire to gather feedback about their survey experience. Participants were asked to describe their understanding of the questions and were encouraged to share any issues or challenges encountered in responding to the questions, as well as suggestions for improvement. In general, the pre-test participants indicated the survey questions were clear and easy to understand; however, they highlighted a few minor issues that entailed revisions to the survey instrument (see Attachment 1 for a summary of the Pre-test findings, including issues identified by respondents and how they were resolved).

B.5. Provide the name and telephone number of individuals consulted on statistical aspects of the design.

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